# T15D13 – (Part 15.4) ****Spontaneity****

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 15.4.1 Predict whether a reaction or process will be spontaneous by using the sign of ΔG. (3)
   1. What is a spontaneous reaction?
   2. Some spontaneous processes need initiation, others do not, give examples of each:
   3. How fast to spontaneous processes occur?
   4. What is a non-spontaneous reaction? Examples?
   5. What is the equation for Gibbs free energy? What do the Gibbs free values mean?

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| **Equation for Gibbs Free Energy** | **When ΔG is negative** | **When ΔG is positive** | **When ΔG is zero** |
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* 1. Example: Calculate the Gibbs free energy change for the following reaction under standard state conditions

N2(g) + 3H2(g) 🡪 2NH3(g)

ΔHθ = -95.4

ΔSθ = -198.3

T = 298K

* + 1. If you wanted to calculate the temperature above which the reaction ceases to occur spontaneously
  1. What does free energy mean?
  2. Example: Calculate the entropy change of the surroundings when water condenses on a window at 25oC T

H2O (g) 🡪 H2O (l)

ΔHθ = -44.0

ΔSθsystem= -118

1. 15.4.2 Calculate ΔG for a reaction using the equation ΔG= ΔH−TΔS and by using values of the standard free energy change of formation, ΔGf . (2)
   1. What does a positive and negative value for ΔGθf mean?

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|  | **Stability** | **Result** |
| **ΔGθf is negative** |  |  |
| **ΔGθf is positive** |  |  |

* 1. What is the equation for Gibbs free energy of reaction?
  2. Use the following Gibbs free energy change of formation, ΔG θf, for the decomposition of magnesium carbonate

MgCO3(s) 🡪 MgO(s) + CO2(g)

ΔG θf[MgCO3(s)] = -1012

ΔG θf[MgO(s)] = -569

ΔG θf[CO2(g)] = -394

1. 15.4.3 Predict the effect of a change in temperature on the spontaneity of a reaction using standard entropy and enthalpy changes and the equation ΔG=   
   ΔH − TΔS. (3)
   1. Positive entropy values help drive a reaction
   2. Negative enthalpy values help drive a reaction

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| **Enthalpy Change ΔH** | **Entropy Change ΔS** | **Gibbs Free energy Change ΔG** | **Spontaneity** |
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* 1. Draw a diagram to represent this effect:
  2. Examples of calculations are provided on the power point, feel free to copy down as a reference